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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/707,021	11/14/2003	James C. Bartelo	FIS920030197US1	1020
29154	7590	11/30/2004	EXAMINER	
FREDERICK W. GIBB, III MCGINN & GIBB, PLLC 2568-A RIVA ROAD SUITE 304 ANNAPOLIS, MD 21401			CHU, CHRIS C	
			ART UNIT	PAPER NUMBER
			2815	

DATE MAILED: 11/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/707,021

Applicant(s)

BARTELO ET AL.

Examiner

Chris C. Chu

Art Unit

2815

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 September 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 - 22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 - 22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 September 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Applicant's amendment filed on September 13, 2004 has been received and entered in the case.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1 - 22 are rejected under 35 U.S.C. 102(b) as being anticipated by Andricacos et al. '320.

Regarding claims 1 and 12, Andricacos et al. discloses in e.g., Fig. 1, Fig. 2, column 1, line 64 – column 2, line 4, column 4, lines 57 – 64, column 5, lines 38 – 48 and column 7, lines 1 – 10 an integrated circuit structure comprising:

- internal circuitry (active IC devices and circuits); and
- an interconnect (12, 16, 18, Cu cap layer and 20) on an external portion of said structure, said interconnect comprising:
 - o a metal layer on a substrate (12; e.g., Al);
 - o a first copper layer (16c; Cu) on said metal layer;

- a barrier layer (18; e.g., Ni) on said copper layer;
- a stabilizing copper layer (Cu cap layer; column 7, lines 1 - 4) on said barrier layer; and
- a tin-based solder bump (20; e.g., eutectic PbSn alloy) on said barrier layer,
- wherein said stabilizing copper layer comprises a “sufficient amount” of copper.

Furthermore, since the structure recited in Andricacos et al. is same in structure to that of the claims, the following limitation “to balance the chemical potential gradient of copper across said barrier layer” is inherent in Andricacos et al.

Regarding claims 2 and 13, Andricacos et al. discloses in e.g., Fig. 1, Fig. 2, column 1, line 64 – column 2, line 4, column 4, lines 57 – 64, column 5, lines 38 – 48 and column 7, lines 1 – 10 said stabilizing copper layer comprising a “sufficient amount” of copper. Furthermore, since the structure recited in Andricacos et al. is same in structure to that of the claims, the following limitation “to prevent copper within said first copper layer from diffusing across said barrier layer” is inherent in Andricacos et al.

Regarding claims 3 and 14, Andricacos et al. discloses in e.g., Fig. 1, Fig. 2, column 1, line 64 – column 2, line 4 and column 7, lines 1 – 10 the tin-based solder bump comprising a copper rich solder alloy (since the copper in the Cu cap layer dissolves in the Sn-based solder to form Cu/Sn intermetallics, the tin-based solder bump of Andricacos et al. read as a copper rich solder alloy).

Regarding claims 4, 9, 15 and 20, Andricacos et al. discloses in e.g., Fig. 1, Fig. 2 and column 4, lines 57 – 64 said metal layer (12) comprising diffusion metallurgy including Al.

Regarding claims 5, 10, 16 and 21, Andricacos et al. discloses in e.g., Fig. 1, Fig. 2 and column 5, lines 45 – 48 the barrier layer (18) comprising Ni.

Regarding claims 6, 11, 17 and 22, Andricacos et al. discloses in e.g., Fig. 1, Fig. 2 and column 7, lines 8 – 10 said tin-based solder bump (20) comprising a eutectic PbSn solder.

Regarding claims 7 and 18, Andricacos et al. discloses in e.g., Fig. 1, Fig. 2, column 1, line 64 – column 2, line 4, column 4, lines 57 – 64, column 5, lines 38 – 48 and column 7, lines 1 – 10 an integrated circuit structure comprising:

- internal circuitry (active IC devices and circuits); and
- an interconnect (12, 16, 18, Cu cap layer and 20) on an external portion of said structure, said interconnect comprising:
 - o a metal layer on a substrate (12; e.g., Al);
 - o a first copper layer (16c; Cu) on said metal layer;
 - o a barrier layer (18; e.g., Ni) on said copper layer;
 - o a copper and tin-based solder alloy bump (20; e.g., eutectic PbSn alloy with Cu that is dissolved from a Cu cap layer) on said barrier layer,
 - o wherein said copper and tin-based solder alloy bump comprises a “sufficient amount” of copper.

Furthermore, since the structure recited in Andricacos et al. is same in structure to that of the claims, the following limitation “to balance the chemical potential gradient of copper across said barrier layer” is inherent in Andricacos et al.

Regarding claims 8 and 19, Andricacos et al. discloses in e.g., Fig. 1, Fig. 2, column 1, line 64 – column 2, line 4, column 4, lines 57 – 64, column 5, lines 38 – 48 and column 7, lines 1

– 10 said copper and tin-based solder alloy bump comprising a “sufficient amount” of copper. Furthermore, since the structure recited in Andricacos et al. is same in structure to that of the claims, the following limitation “to prevent copper within said first copper layer from diffusing across said barrier layer” is inherent in Andricacos et al.

Response to Arguments

4. Applicant's arguments filed September 13, 2004 have been fully considered but they are not persuasive.

On page 7, applicant argues “the capping layer would not be sufficiently thick or have sufficient material to balance the chemical potential gradient of copper across the barrier layer, as in the claimed invention.” This argument is not persuasive. First, the limitation “sufficient” is a broad term and in light of its breadth, the amount of copper in the *copper* layer of Andricacos et al. is considered to be “sufficient.” Also, applicant argues that the layer of Andricacos et al. is not thick enough for anticipation. However, no limitation as to thickness is included in the claims, nor is a required thickness taught in the specification. Finally, the limitation “to balance the chemical potential gradient of copper across the barrier layer” is a functional limitation. While there is nothing wrong with reciting functional limitations in a device claim, the PTO's burden in assessing anticipation of those limitations requires only a reason to believe that the functional limitation is inherent in the prior art. *In re Schreiber*, 44 USPQ2d 1429, 1432 (Fed. Cir. 1997), citing *In re Swineheart*, 169 USPQ 226, 228 (CCPA 1971). Instantly, there is no reason to believe that the copper layer of Andricacos et al. does not have a sufficient amount of copper such that it will not balance a potential gradient across the barrier layer as there is no

Art Unit: 2815

teaching in the specification as to how that function is achieved aside from merely providing a layer of copper; there is no teaching of a specific or required density, thickness, or any other parameter that distinguishes over Andricacos et al. Because Andricacos et al. provides a layer of copper in the physical arrangement as claimed, it is considered to meet the structural and functional limitations of the claim and the argument is not persuasive.

On page 8, the first paragraph, applicant argues “Andricacos et al. ... column 6, lines 33 – 34 prohibit the use of the capping layer when the terminal metal layer is copper.” However, this argument relates to an embodiment of Andricacos et al. that was not used in the rejection (nor is it used in the instant rejection) and is not persuasive. For example, the cap layer in column 6, lines 33 – 34 of Andricacos et al. is an additional copper layer for a BLM 16 when the terminal metal layer 16c is not a copper, which is under the barrier layer 18, in one of embodiments of Andricacos et al. In other words, the layer 16 contains a first adhesion metal layer 16a, a second adhesion metal layer 16b, a terminal metal layer 16c that is not a copper, and an additional copper cap layer between the top of the layer 16c and under the barrier layer 18. As explained in the above, the copper cap layer (column 7, lines 1 – 4; asserted in this and previous Office actions) on top of the barrier layer 18 in Fig. 1 is a different cap layer in another embodiment of Andricacos et al. Since Andricacos et al. clearly discloses in Fig. 1 and Fig. 2 the copper layer (column 7, lines 1 – 4) formed on the surface of barrier layer (18) when the underlying terminal metal layer is copper (16c in Fig. 2 and column 5, lines 39 – 42), Andricacos et al. discloses every element in the rejected claims.

For the above reasons, the rejection is maintained.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a). A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is 571-272-1724. The examiner can normally be reached on 11:30 - 8:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 517-272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR


Art Unit: 2815

system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Chris C. Chu
Examiner
Art Unit 2815

c.c.

Wednesday, November 17, 2004


GEORGE ECKERT
PRIMARY EXAMINER